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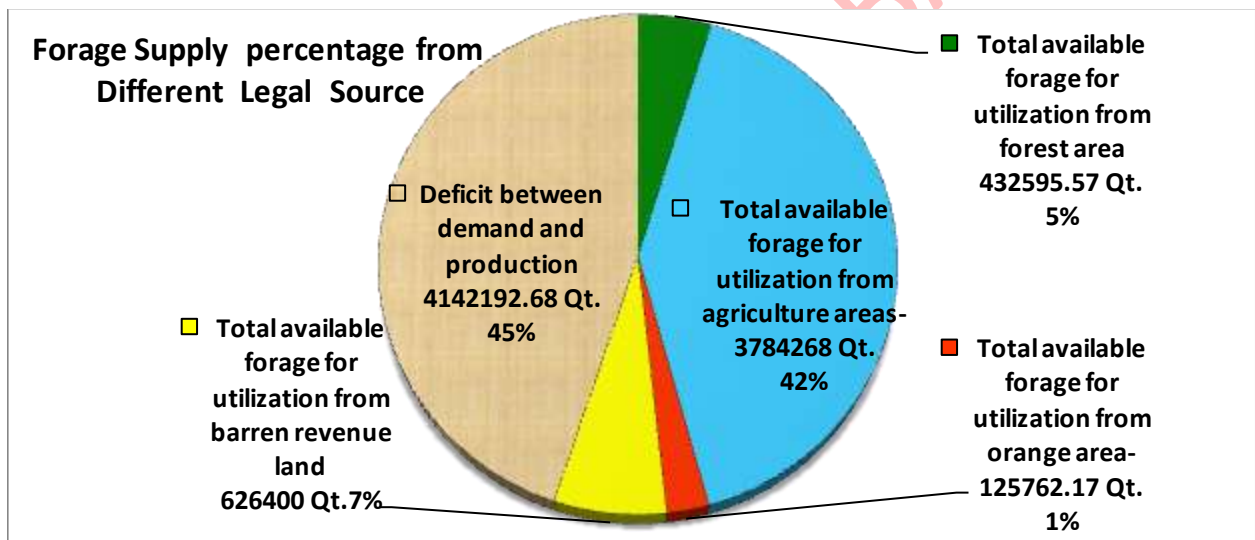
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Variable Stratum code	Avg. annual forage production per ha. in Qt. (within protected area)	Existing prescription for carrying capacity	Allowable carrying capacity in Animal Unit /ha/day basis	Allowable carrying capacity in ha./Animal Unit /day basis
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THU	3.54	1	0.09	10.36
MHU	5.31	1	0.14	6.87
THH	5.54	1	0.15	6.5
MHH	6.27	1	0.17	5.82
TMP	19.64	1	0.53	1.85
MMP	19.9	1	0.54	1.83
TMU	4.75	1	0.13	7.6
MMU	14.32	1	0.39	2.54
TMH	12.02	1	0.32	3
MMH	17.37	1	0.47	2.1
TLP	36.36	2	0.99	1
MLP	47.43	2	1.29	0.76
TLU	19.1	2	0.52	1.91
MLU	34.43	2	0.94	1.06
TLH	9.65	2	0.26	3.78
MLH	11.1	2	0.30	3.2

First word of stratum code - T = Teak Forest Type, M=Miscellaneous Forest Type,

Second word of stratum code – H = High Canopy Density, M=Middle canopy density, L=Low canopy density.

Third word of stratum code – P = Plain Topography, U= Undulating Topography, H= Hilly Topography

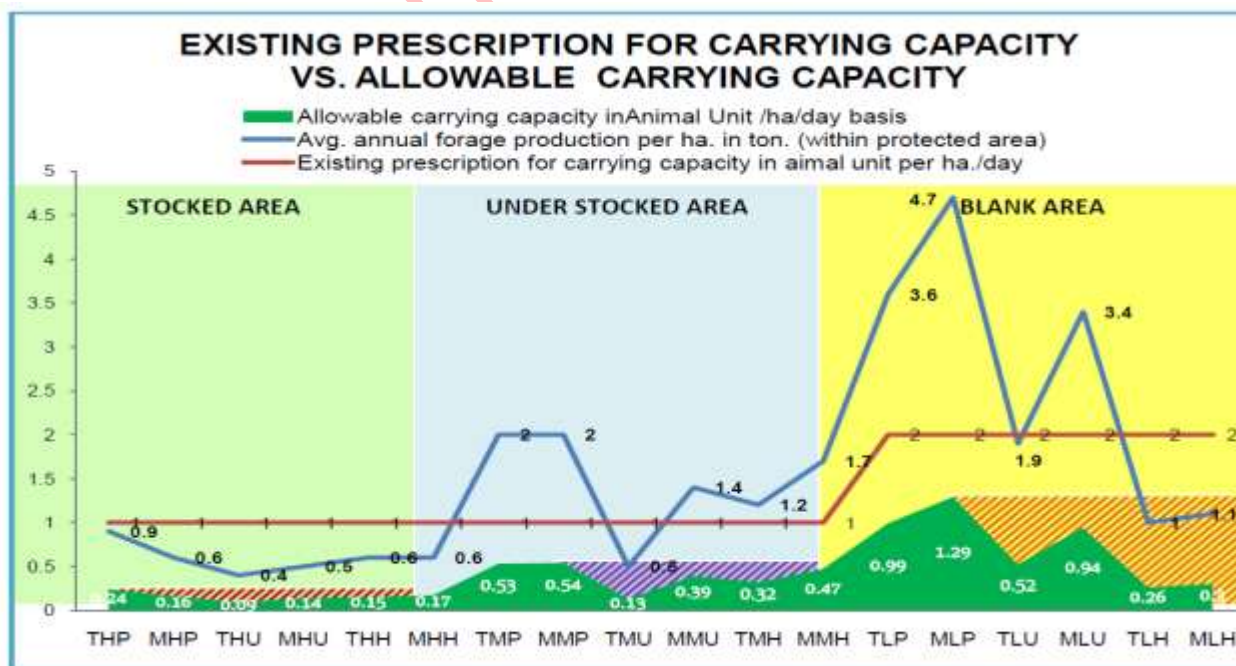
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pkjbz grq Lohdk; L mi yC/k pkjs dh dty ek=k dks 5 fdykskte ifrfnu ifr i'kq bdkbz dh vko'; drk l s Hkkx nus ij ifr i'kq bdkbz okf"kd i kfjLFkfrdh; l oguh; l xg.k nj (**Ecological Sustainable Stock Rate**) i klr gsrh gA bl l xg.k nj dks fof'k"V Lrj ds dty {ks=Qy l s fohkfrtr djus ij Lohdk; L {kerk dk vkdyu vufr i'kq bdkbz ifr gDVs j ifrfnu vuq kj i klr gsrk gA vl; bdkbz vko'; d gDVs j ij ifr i'kq bdkbz ifr fnu ea pkjbz ogu {kerk Kkr djus grq fof'k"V Lrj ds dty {ks=Qy dks i kfjLFkfrdh; l oguh; l xg.k nj (**ESSR**) l s fohkfrtr fd; k tkrk gA

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Project Title: Estimation of carrying capacity of grazing in different forest types and canopy densities in Jabalpur forest division of Madhya Pradesh

PI.: Mayank M. Verma [email- mayanksfri@gmail.com](mailto:mayanksfri@gmail.com)

Funding Agency: APCCF (Development), MP Forest Deptt.

Executive Summary:

Introduction

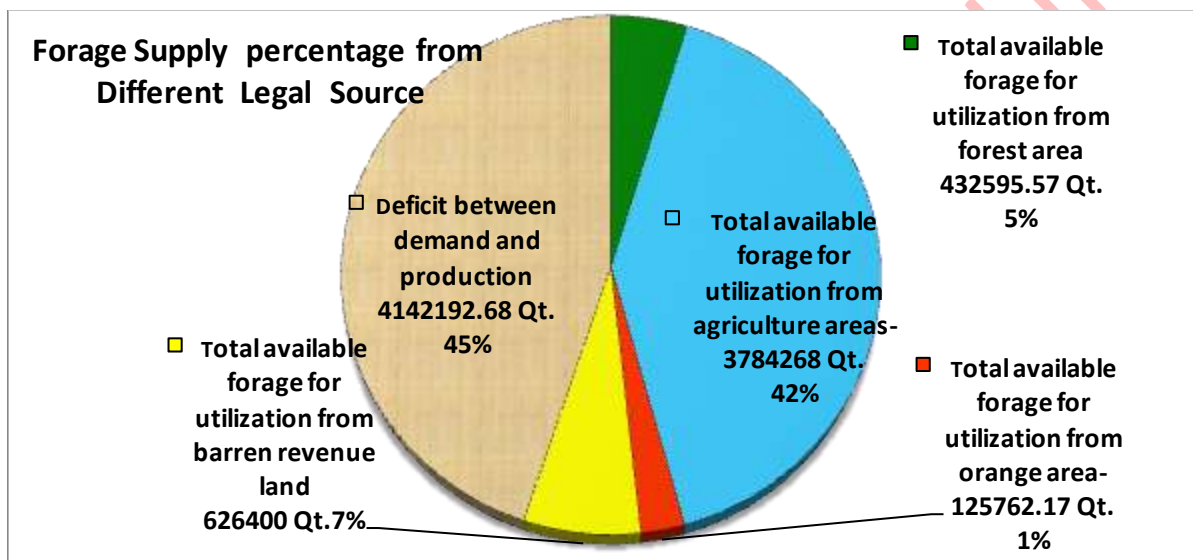
Uncontrolled grazing, not only does tremendous damage to forestlands by hindering forest reproduction, retarding growth and bringing forests to lower ecological level, it also brings about disaster to the community by increasing the intensity of flood through reducing the watershed values of forestlands. Over grazing has been playing havoc with the health, productivity and sustainability of forests. Although adverse effects of over-grazing have been well known to foresters, there has been no systematic study to determine the carrying capacity of grazing in different forest areas, categorized on the basis of forest types and canopy density. To ensure that the animals have sufficient forage to remain healthy and to ensure that grazing does not permanently damage soil and vegetation resources, animal numbers and/or grazing time must be controlled. If either too many animals are allowed to graze or animals are allowed to graze, for too long, forage will be adversely affected. Repeated removal of forage by grazing animals will weaken plants and allow less palatable plants to replace them. Eventually, all forage plants will be eliminated from a pasture, if heavy grazing is left unchecked. Hence, this project was taken up in Jabalpur forest division to determine the carrying capacity of grazing in forests of different types and canopy densities. Jabalpur forest division falls in the category of a division with slightly heavy grazing. Sixteen districts belong to this major category, due to this reason an in accordance with the instructions given in the 38th RAC meeting of the institute, Jabalpur forest division was selected for pilot study. This study aims to enrich the existing literature on why and how applying carrying capacity to rangeland management. The application of carrying capacity to rangeland management based on equilibrium assumptions has been the very essence of state policy on range management. Even if the concept of carrying capacity is relevant to rangeland management depending on rangeland ecosystems, a meaningful application depends on how carrying capacity is determined. This study reveals that the determination of carrying capacity in practice has more to do with political and economic factors than with ecological factors.

Study area: The study area spans through all the reserved and protected forests and demarcated orange area of Jabalpur Forest Division. The tract dealt with lies in between North latitude 22° 50" to 23°37" and east longitude 79° 20" to 80°34".The total notified forest area of Jabalpur division is 788.56Sq.Km.The forest of the Jabalpur Division area fall under the sub group 5-A C 1 B (Southern

tropical dry deciduous forest- Dry Teak forest) and 5 A C 3 (Southern tropical dry deciduous forest- Southern dry mixed deciduous forest) according to H.G. Champion and S. K. Seth.

Conclusion and recommendation

The Jabalpur district had 365345 cows, 95324 buffaloes, 1170 sheep, 104280 goats, 118 horses and 21 donkeys according to livestock census 2012. Within this population 1947 Cattle and 25975 Buffaloes are recognized belonging organized dairies who are stall fed (non-forest dependent). Thus total animal unit present in Jabalpur district 5,05,225AU by unit conversion as per MP grazing rule 1986.



Deficit between demand and production is 45% or **4142192.68 Qt.** Deficit can be compensated up to some extent by efficient and effective silvi-pasture interventions in 8030.79 hectares Orange area and 40,000 hectares barren revenue land. Although we could not fix total animal unit liability for forage supply from forestland, it should be **propositional** to area percentage of gross area. The total forest area percentage is 10.76% of total geographic areas of Jabalpur Division, so it could be presumed that forest area in Jabalpur district should carry only 10.76 % grazing animal units of Jabalpur district. Our current study findings determine that forest area is able to carry only 5 % Animal Units rather than 10.76 % its liability. It clearly indicates that forest area of Jabalpur district suffers two point three times load than its carrying capacity. This load is responsible for deterioration in the ecological conditions. Apart from high biotic pressure beyond the carrying capacity of forest area, cattle grazing in the forest are also malnourished due to lack of availability of forage in adequate quantity. Forage supply from different sources is around 65%, cattle can obtain dry forage at the rate of 5 kg per animal unit per day from forest area, agriculture area (straw, para, khali etc.) and other alternative stall feeding.

It is clear that the dry forage is sufficient only for 65% cattle are being shared by 100% of cattle. Thus $65 \times 5 = 325 \text{ kg}$. $325 \text{ kg} \div 100 = 3.25 \text{ kg}$. (Shared available dry forage for per AU per day basis). Thus in Jabalpur district all domestic cattle are underfed giving clear indication of malnutrition. They are getting on an average only 3.25 kg. dry forage per day instead of 5 kg., therefore do not yield much milk in the most of the rural areas.

Recommendations: Stratum wise recommendations for carrying capacity of grazing for Jabalpur forest division as shown below in table:-

Variable Stratum code	Avg. annual forage production per ha. in Qt. (within protected area)	Existing prescription for carrying capacity	Allowable carrying capacity in Animal Unit /ha/day basis	Allowable carrying capacity in ha./Animal Unit /day basis
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First word of stratum code - T = Teak Forest Type, M=Miscellaneous Forest Type,

Second word of stratum code – H = High Canopy Density, M=Middle canopy density, L=Low canopy density.

Third word of stratum code – P = Plain Topography, U= Undulating Topography, H= Hilly Topography

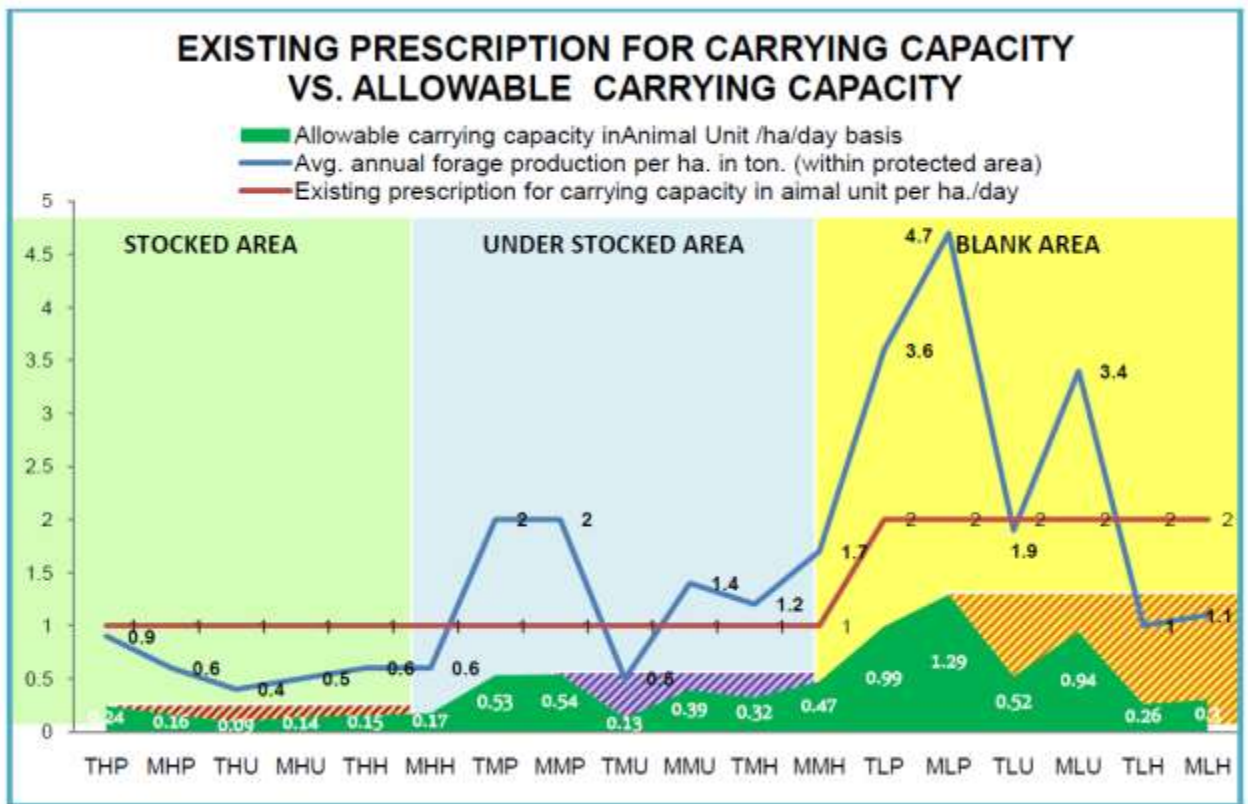
We have estimated carrying capacity of grazing individually all possible 18 stratum of Jabalpur division. We have discussed before that all stratum represents specific combination of forest type, canopy density and topography classes as variables of study. Carrying capacity of grazing calculated of each stratum on annual forage productivity basis of the unit forest area (hectare). Then unit area forage production is multiplied by total area of stratum. Find out total forage production annual basis of each stratum multiplied with allowable forage utilization factor, which is 0.5., by getting this deducted amount of forage divided by one animal unit per day forage

requirement (5kg) for 365 days. Obtained value is ecological sustainable stocking rate. These ecological sustainable stocking rates (ESSRs) values divided by total area of specific stratum to derive allowable carrying capacity of each stratum in animal unit per hectare per day basis. One another way to express carrying capacity is in hectare per animal unit per day is obtained when total stratum area in hectare divided by ESSR value.

There are mainly three classes of canopy density which influences forage production Low C.D., Mid C.D. and High C.D.

- High Canopy Density (Stocked areas) belonging stratum carrying capacity estimated 0.09 to 0.24, average 0.16 animal unit per hectare while existing prescription for carrying capacity is 1.0 animal unit per hectare.
- Middle Canopy Density (Under stocked) belonging stratum carrying capacity estimated 0.13 to 0.54, average 0.33 animal unit per hectare while existing prescription for carrying capacity is 1.0 animal unit per hectare.
- Low Canopy Density (Blank areas) belonging stratum carrying capacity estimated 0.26 to 1.29, average 0.77 animal unit per hectare while existing prescription for carrying capacity is 2.0 animal unit per hectare.

Grazing capacity can be improve by *Latana camara* moping, *Hyptis suaveolens* (L.), *Parthenium hysterophorus* and *Xanthium strumarium* eradication work within this class of canopy density. Soil moisture conservation work along with broadcasting of palatable grasses like *Dichanthium annulatum*, *Themeda quadrifolia* sp., *Iselima laxum*, *Apluda mutica*, *Heteropogan contortus* and *Chloris barbata* immediately after weed eradication required. Low Canopy Density areas are major source of forage production but due to uncontrolled grazing they have lost their competence to produce fine palatable grass forage while producing huge biomass of weeds. Protection from free ranging cattle and weed eradication programme should be taken on priority basis along with immediate seed broadcasting of wild palatable grasses. Mosaic fire treatment for weed removal before the flowering up to next 5 subsequent years is strongly prescribed at this juncture. Produced grass forage may be distributed only for the purpose of stall feeding but strictly after the flowering period. Stall feeding culture should be promoted through free supply of forage by forest department.



Norms for permissible limits of grazing in forests have been fixed by the state forest department on the basis of legal classification of forest i.e. Reserve and Protected forest. For reserve forest (RF) the norm is one cattle unit per hectare of forest area whereas it is two cattle units per hectare in case of protected forest. The rationale behind these differential norms seems to be two fold. First, it is assumed that R.F.s are in general, better stocked with higher canopy density as compared to P.F.s. Therefore, availability of grass under heavier shade will be less in R.F.s. The second reason lower permissible limit of grazing is that RFs are less burdened with rights and concessions including those of related to cattle grazing and more stringent protection measures are applicable. However, it has been observed that in many cases, the situation with regard to density of stocking is not what to expected and PFs may sometimes have better canopy density and consequently less abundance of grasses. Therefore, it is recommended that while determining carrying capacity of grazing, ecological considerations should prevail over the legal classification of forest.

Transfer of Technology to the field:

Initial carrying capacity as described in recommendation and conclusions are enough to determine the carrying capacity of different stratum of Jabalpur forest Division. Carrying capacity can finally adjusted by long term monitoring to adjust the seasonal climatic impact. We have developed suitable methodology, which can be adopt to estimate carrying capacity of others divisions of Madhya Pradesh. We have developed software *“Estimation of Carrying Capacity”* on the basis of above said methodology to estimate stratum wise carrying capacity of remaining forest divisions of Madhya Pradesh.